coming months, the problem of forecasting the character of a season would be capable of solution.

W. U.

OLIVINE ROCKS OF NORTH CAROLINA.

MUCH interest was attracted a number of years ago to the olivine rocks of North Carolina by the excellent paper of Dr. Genth, on 'Corundum and its alterations.' These rocks are also well known practically from their association with the mica and corundum mines of that state: hence any thing tending to elucidate the origin and history of these immense masses of olivine is of value. There has been recently published, in the Proceedings of the Boston society of natural history, a paper by Dr. Alexis A. Julien on these olivine rocks, which is of great value, even if some exceptions may be taken to his conclusions. The particular variety of olivine rock in North Carolina is designated as dunite; it having been named from Mount Dun in New Zealand, from which locality rock of this character was first described. In North Carolina the rock is found in oval or lenticular masses in a hornblendic gneiss; and a 'marked slaty lamination' is looked upon by Dr. Julien as stratification which dips at a steep angle. His reasons for regarding this banded structure as bedding-planes are, that, on microscopic study of thin slices, there is seen an alternation of coarser and finer irregular grains. Again: grains of chromic iron are found not only dispersed throughout the rock-mass, but also in thin bands alternating with the olivine bands. He found, however, a sharp break between the lamination of the olivine rock and the foliation of the hornblendic gneiss surrounding it. Again: when there has not been formed in the rock some material, of later date than the time the rock came into place, which serves as a cement to hold the olivine grains together, the rock is pulverulent and friable, like a loosely consolidated sand.

From the above, Dr. Julien draws the conclusion that this dunite is neither of chemical nor of eruptive origin, but rather an accumulation of *débris* from some older olivine rock of eruptive origin; that is, it is an olivine sandstone. The chief defect in Dr. Julien's reasoning is, that all the evidence which he gives in support of this view could exist equally well if the rock had some entirely different origin. In order to prove that any thing must have been formed in any particular way, we ought to seek for certain characters in it which could have been produced in that way alone.

Messrs. W. C. Kerr and C. D. Smith, who have spent much time in studying this olivine rock in the field, declare in favor of the eruptive origin of it; but they have published little or none of the evidence upon which their conclusion rests, and therefore one cannot judge as to its correctness. Every rock carries within itself, or in its relations to others, the story of its origin and subsequent history with more or less completeness. The correct reading of that story depends upon our skill and knowledge. If a rock is deposited in the hollows of another as a beach formation, it is easy to see that the effect it produces upon the boundary-rock is different from its action upon them as a lava-flow or an intrusive mass. So the last two cases present different relations, according to their origin, to the surrounding rocks. As a rule, it can hardly be considered safe to positively declare what the origin of an old crystalline rock is, until these relations have been carefully ascertained; and in this direction Dr. Julien's work is defective. The present writer's microscopic study of the North Carolina dunite showed him that the rock he was studying, even when destitute of some cementing-material, was not friable and pulverulent, while the sections to his mind presented characters belonging to eruptive rocks only. The olivine grains are separated by fine fissures, but every irregularity in the outline of one is matched by a corresponding irregularity in the adjacent bounding-grains. If these grains had been water or wind worn olivine sand, no such matching of the parts would have been possible. This any one can readily see for himself if he will examine any conglomerate, and observe the amount of interstitial material it takes to hold together and fit the pebbles to one another. Then let him remember that a sandstone is a conglomerate on a small scale, and, under the microscope, a conglomerate to the eye as much as the other is to the unaided vision. The olivine rock now under consideration has absolutely no interstitial spaces and no binding-material, but the grains are fissured and separated the same as the adjacent portions are separated in cracked and fissured glass. From this the conclusion naturally follows, that such structure indicates that these olivine grains were formed by the cracking of an olivine mass during the process of solidification, crystallization, and cooling; that is, from an eruptive mass.

Further, individuals of olivine are seen in polarized light to be made up of a number of distinct grains, as much separated by fissures from one another as the distinct individual grains are elsewhere in the section. This is a natural and common occurrence in an eruptive rock, but in a sedimentary one the parts ought to be scattered. Many of these individuals, too, are long, wedge-shaped masses with sharply pointed ends. If they had been water or wind worn grains they ought to have had these sharp edges worn, rounded, and broken. These long, lenticular, fissured individuals are also arranged at every angle to one another, when, if the rock were sedimentary, they ought to lie nearly parallel, and on their sides.

The alterations of the dunite described by Dr. Julien are important and interesting because they give rise to veins and other rocks. The corundum in these veins is looked upon as a secondary product, and not, as Dr. Genth held, the primary material from which many rocks originated. The change of the olivine rock to different rocks leads to the production of chalcedonic or cherty forms, hornblendic schists, talc schists, serpentine, etc. The change to serpentine comprises every variation, "from that in which the serpentine is diffused among the olivine

granules, merely as a minute fibrous network, or as films enveloping olivine cores, to that in which only minute particles of olivine survive as the nuclei of the granules, and to the final result of a true and complete serpentine."

Dr. Julien further claims, that the actinolites, amphibolites, hornblende schists, and many of the talc schists, steatites, and serpentines of the Appalachian belt, are the equivalents of the dunite of North Carolina.

The objections to some of Dr. Julien's views have not been offered from any spirit of criticism of his truly excellent paper, but for the purpose of causing a more thorough study of the field-relations of this rock, and a presentation of the evidence that study affords. If the evidence, then, sustains Dr. Julien's conclusions, his views will be accepted unhesitatingly. He has, indeed, given more evidence for his opinions than most writers on crystalline rocks are inclined to offer; for, as a rule, they appear to consider their mere dictum sufficient to prove the origin of any rock. It would seem that the time has come when statements regarding the origin of crystalline rocks cannot be accepted from *any* observer, unless these claims are accompanied by full and decisive proof of their correctness. To bring about this healthy state in the study of the North-American rocks, the present writer has labored for years, and will continue to labor.

M. E. WADSWORTH.

ABOUT GREAT TELESCOPES.

DR. RALPH COPELAND of Dun Echt, near Aberdeen, when returning to Scotland by way of this country a few months since, made a tour of several North-American observatories; and in a late number of *Copernicus* he contributes a paper on the Dudley observatory at Albany, the Litchfield observatory of Hamilton college at Clinton, the Warner observatory at Rochester, the Toronto observatory (Canada), the McGill college observatory (Montreal), the Harvard college observatory (Cambridge), the Winchester observatory of Yale college (New Haven), the two observatories at Princeton, and the U.S. naval observatory (Washington). The noteworthy portions of the equipment of these establishments are briefly dealt with, and the work generally specified on which they are employed. Dr. Copeland, having enjoyed the good fortune of seeing through a number of the finest telescopes in all parts of the world, places on record, at the conclusion of the paper, his general impressions of the actual state of telescope-construction on both sides of the Atlantic.

First as regards their optical merits: it does not seem to him that any material difference as to the mere power of separating close double stars exists in the object-glasses made by the chief opticians in Europe and America. On a night of good definition, any of their telescopes may be trusted to divide a fairly equal pair of stars at a distance indicated by Dawes's table,[1] of which the following is a sufficient specimen: —

[1] Mem. roy. astr. soc., xxxv. 158.

Aperture in inches.	Least separable distance.
1.0	4.56″
2.0	2.28
3.0	1.52
4.0	1.14
6.0	0.76
8.0	0.57
10.0	0.46
12.0	0.380
15.0	0.304
20.0	0.228
25.0	0.182
26.0	0.175
27.0	0.169
30.0	0.152

We thus see that in this respect our telescopes are practically perfect, and also that the atmosphere on the very best nights is sufficiently steady to permit their full power to be used. If, however, we test them on double stars, of which the components differ very much in brilliancy, then it is by no means so easy to come to a certain conclusion. There is the secondary spectrum to contend with, respecting the character of which it may be said that a certain degree of personal taste or fashion exists. Some persons, notably opticians, seem to be little disturbed by a decidedly blue glare, while others prefer a wine-colored fringe. Perhaps, indeed probably, there is a physiological difference in the observers; for, if we suppose a person to be blind to the extreme blue and the violet rays only of the spectrum, to him an over-corrected object-glass would be perfect. With it he would be able to make out the closest companions of blue stars, or to see comparatively faint ones right up to the moon's bright limb. To such a person, however, an object-glass under-corrected to the same extent would appear to be a decidedly bad one. To Dr. Copeland, as well as to many of his colleagues, an average glass by Cooke or Grubb, and, to a less extent, by Clark, appears over-corrected; while one by Schröder, and some of the Munich glasses, appear under-corrected. But here an important practical difference enters into consideration, one which has been particularly experimented on by Mr. Russell of Sydney; viz., that the correction of an object-glass may be lessened by separating the lenses: so that an over-corrected object-glass may be adjusted to any desired extent, while one that is under-corrected can only be used in the state in which it left the maker's hands. As an example, it may be mentioned that the somewhat over-corrected object-glass of the 15-inch equatorial at Dun Echt has been materially improved by separating its lenses 0.2 of an inch, while a separation of 0.3 of an inch was found to throw out too much red about the primary image. This degree of improvement is best shown by the extremely linear character of the spectra of stars which it now gives. But in this connection it is only fair to mention, that, in making this object-glass, Mr. Grubb was limited to the relatively short ratio of 12 to 1 between the focal length and aperture. Opticians have not neglected to avail themselves of this property; and